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# Effects of Ground Vibrations from Blasting at Open-Cuts, Ravensworth, N.S.W.



by

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## ILLUSTRATION

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## 1. INTRODUCTION

From 8th to 15th December, 1950, a study of the vibrations set up by explosions in the open-cut coal workings at Ravensworth was undertaken by the Bureau of Mineral Resources, Geology & Geophysics. The study was made at the request of the New South Wales Mining Coy., which was operating two open-cuts through contractors.

Complaints had been received from two property owners that their houses were being damaged by the blasting in the open-cuts.

In interpreting the results of the survey, it was decided to use the same methods as used by Rayner and Hanlon (1943) in their survey of the Ball's Head Area, Sydney. This treatment gives the largest likely value for the total amplitude of the vibrations.

A horizontal recording machine was used on the survey but the records obtained from it were not used in calculating the total amplitude because of the small number of records made. Instead, the following formula was used -

$$T = (V^2 + H^2)^{\frac{1}{2}}$$

$$= (V^2 + (6.32)^2 V^2)^{\frac{1}{2}}$$

$$= 6.4V$$

(6.32 is regarded as the largest possible value for H/V)

Where T, V and H are the total, vertical and horizontal components respectively.

## 2. INSTRUMENTS USED

(i) The Mechanical Seismograph. This was used to record vertical disturbances. Essentially, it consists of an inertia mass of 22 lbs. suspended from an aneroid type spring and attached by a lever movement to a pen which "writes" on a rotating drum. The magnification of the instrument is ~~70:1~~ 7:1 and its natural frequency is 1 cycle per second.

(ii) The Cambridge Vibrograph. This was used to record horizontal disturbances. The vibrograph consists of an inertia mass supported by two flat steel springs. The weight operates on a

sapphire-pointed stylus which scratches on a celluloid film. By the use of an appropriate stylus, the instrument can be made to record with a magnification of 5:1 or 1:1. The record is inspected in a "viewer" which magnifies a further 10 times. The natural frequency of the instrument is 5 c.p.s.

This instrument can also be used to measure vertical disturbances.

3. OBSERVATIONS AT MR. COWLEY'S HOUSE.

Mr. Cowley's house is a substantial brick dwelling, about 2,400 feet from No. 1 Open-cut and about 4,800 feet from No. 2 Open-cut.

For the first two observations the instruments were set up in a hall at a position where Mr. Cowley claimed that damage was occurring.

The horizontal recorder was arranged with the suspension pointing directly to the course of the shots. The third observation was made in a spare room with the suspension of the vibrograph perpendicular to the direction to the shot.

The first two shots recorded were fired in overburden and the third in coal. In each case the instruments were set up on a wooden floor.

The largest total amplitude calculated from the shots was 0.0298 inches. This is below the amplitude (0.09 inches) usually regarded as likely to damage a house. ~~This total amplitude was calculated on the basis of a 500 lb. shot.~~ The contractors (Davis Contractors) working this cut stated that the 170 lbs. of AN50 gelignite fired in the second shot was the largest charge they have used and the largest they are likely to use. No records of the weight of past charges were available.

Mr. Cowley, who was present while the observations were made, claims that the shots were not typical. He states that, on a number of occasions, the windows of the house rattled and vibrations could be felt. Neither of the observers noticed such effects while recording.

A peculiarity of the first record is worth noting. A fraction of a second before the first wave was received, a vertical pulse appears. The pulse is of an extremely high frequency (not measurable) and does not appear to have any connection with the explosion. There is no corresponding feature in the vibrograph record. Treated as if it were an effect of the shot, the total amplitude is 0.0736 inches.

Some records were made at Mr. Cowley's house of normal household movements such as people running, jumping and walking within the house. These gave larger amplitudes than the blasts for positions close to the instruments, but at distances of 15 feet or more were hardly detectable. For three of these records the vibrograph was arranged to operate vertically as a check on the seismograph. The correlation was poor, possibly because of the difficulty of transmitting a shock equally to the two instruments.

In conclusion, it does not seem likely that Mr. Cowley's house is being damaged by the open-cut blasting. The house is 2,400 feet from the workings and charges of the order of 200 lbs. would not be expected to cause damage over that distance. It is unfortunate that more shots were not available to the observers in order to make the results more reliable.

## 4. OBSERVATIONS AT MR. BOOTH'S HOUSE.

Mr. Booth's house is a small weatherboard cottage. The only parts affected, according to Mr. Booth, are the chimney (brick) and hearth-stones (cement).

The house is about 600 feet from ~~the~~ No. 2 Open-Cut and about 2,700 feet from ~~the~~ No. 1 Open-Cut.

Only one shot was available and this was recorded in the kitchen as close to the chimney as possible. The horizontal recorder was placed with the suspension tangential to the direction of the shot.

The shot fired was 900 lbs. of AN60 gelignite in 9 holes in overburden (shale and sandstone). No records of previous charges were available so this result was corrected to 1000 lbs. It is unlikely that larger charges would be used

The corrected total amplitude for this shot was 0.349 inches which is above the lower limit for damage.

A walking test was tried in Mr. Booth's house and gave vibrations with an amplitude of 0.41 inches but these were unlikely to be transmitted to the chimney.

It seems probable that vibrations from blasting at No. 2 Open-Cut are damaging Mr. Booth's house. Moreover, the contractors of No. 2 Open-Cut (Farley and Lewis) will probably have to use larger charges than those being used in the No. 1 Open-Cut because of the greater depth of overburden (32 feet).

## 5 REFERENCE.

Rayner, J.M. and Hanlon, F.N., 1943 - Earth Vibrations from Blasting at Ball's Head, Sydney. Min. Resour.Surv. Rep. 1943/25.

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# Observations at Mr. Cowley's House

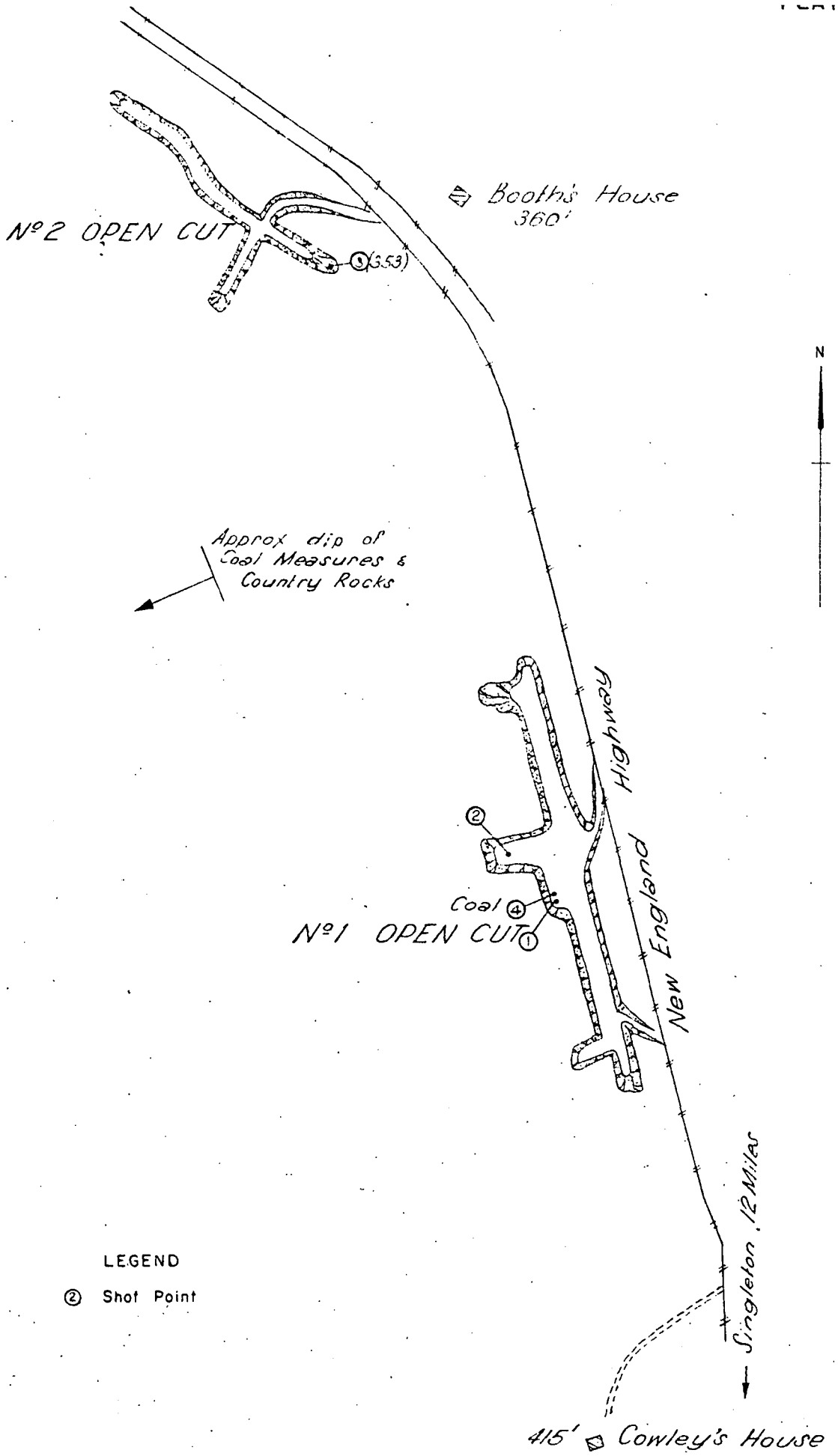
## Vertical Seismograph and Cambridge Vibrograph.

| Record No. | Shot No. | Shot Weight (lbs) | Dist. Shot to Station (feet) | Position of Shot R.L. (feet) | Position of Shot Location in Open-cut. | Position of Instruments Location | Position of Instruments Where placed. | Underlying Rock | Freq. (c.p.s) | Max Amplitude (Inches) Recorded | Corrected to 500lb Shot. | Total. (6.4V) | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 1. | 100 | 2300 | 317 | Centre of No1. | House R.L. 415' | Grnd. Floor Hall | Shale & S'stone | 11 | V. 0·00093 | 0.00465 | 0·0298 | 4 holes in overburden (AN50) |
| 2. | 2. | 170 | 2450 | 331' | Eastern extension of No 1. | House R.L. 415' | " " | " " | 7 | V. 0·00089 | 0·0026 | 0·0166 | 1 hole in overburden (AN50) |
| | | | | | | | | | 15 | H. 0·00079 | 0·0023 (Doubtful) | | |
| 5 | 4 | 160 | 2300 | 317 | Centre of No1. | House R.L. 415' | Grnd Floor ~~Hall~~ Spare Room. | " " | 4. | V. 0·00083 | 0·0026 | 0·0166 | 6 holes in coal. (AN50) |
| | | | | | | | | | 20 | H. 0·0019 | 0·0059 | | |
| | | | | | | Household Disturbances | | | | | | | |
| 6 | Walking in Spare Room. | | | | | House | Spare room | | 6·5 | V. 0·024 | | | |
| | | | | | | | | | 20 | H. ~~0·0024~~ 0·0024 | | | |
| 7. | Jumping 6" off floor 10 feet from instruments (140 lbs). | | | | | " | " " | | 5 | V. 0·0275 (Seismograph) | | | Both instruments operating vertically. |
| | | | | | | | | | 18 | V. 0·0256 (Vibrograph) | | | |
| 8. | Walking around room. | | | | | " | " " | | 6 | V. 0·024 (Seismograph) | | | " " " |
| | | | | | | | | | 12 | V. 0·090 (Vibrograph.) | | | |
| 9. | Walking up and down Hall. | | | | | " | Hall | | 6? | V. 0·017 (Seismograph) | | | " " " |
| | | | | | | | | | 30? | V. 0·053 (Vibrograph) | | | |
| 10. | Walking out of and back into hall. | | | | | " | " | | 6 | V. 0·017 | | | |
| | | | | | | | | | 30 | H. 0·0098. | | | |

## Observations at Mr Booth's House

### Vertical Seismograph and Cambridge Vibrograph

| Record No. | Shot No. | Shot Weight (lbs) | Dist. Shot to Station (feet) | Position of Shot: R.L. (feet) | Position of Shot: Location in Open-cut. | Position of Instruments: Location | Position of Instruments: Where placed | Position of Instruments: Underlying Rock | Freq. (c.p.s) | Max Amplitude (Inches): Recorded | Max Amplitude (Inches): Corrected 1000 to 500 lb Shot | Max Amplitude (Inches): Total (6·9V) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3 | ~~900~~ 900 | 600 | 353 | S.E. branch of No 2. | House R.L. 360' | Kitchen Grd. Floor | Shale & S'stone | ? V | 0·048 | 0·0545 | 0·349 | 9 holes in over burden (AN60) |
| | | | | | | | | | 12 H | 0·028 | 0·0312 | | |
| | | | | | | Household Disturbances | | | | | | | |
| 4. | Walking & running | | | | | House | Kitchen | | 7 V | 0·064 | | | |
| | | | | | | | | | 20 H | 0·0006 | | | |




GEOPHYSICAL SURVEY AT RAVENSWORTH, N.S.W.

SKETCH PLAN OF OPEN CUTS AND HOUSES VISITED

SCALE IN FEET

600 0 600 1200 1800

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